EFFECT OF SOME BIO AND ORGANIC FERTILIZERS ON GROWTH AND YIELD OF SNAP BEAN PLANTS GROWN IN SANDY SOILS

By

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B.Sc. Agric. Sci. (Vegetable Crops), Fac. Agric., Cairo Univ., 2001
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THESIS

Submitted in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

In

Agricultural Sciences

(Vegetable Crops)

Department of Vegetable Crops
Faculty of Agriculture
Cairo University
EGYPT

2015

APPROVAL SHEET

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Title of Thesis: Effect of Some Bio and Organic Fertilizers on Growth and Yield of Snap Bean Plants Grown in Sandy Soils.

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ABSTRACT

Two field experiments were carried out in the sandy soil of El sadat city, Monofia Governorate during the two successive seasons of 2010/2011 and 2011/2012 to study the response of snap bean (*Phaseolus vulgaris*, L., cv. Paulista) to organic, inorganic and / or bio- fertilizer application.

The first experiment studied the response of snap beans to 50% of the recommended inorganic N fertilizer combined with some strains of *Rhizobium leguminosarum* biovare phaseoli and "Biofertile". The combination between inorganic fertilizer and the mixed inoculum of Biofertile plus and the multi-strain rhizobial inoculum supported maxima plant vegetative growth, green pods yield and pod NPK percentages.

The second experiment dealt with the effect of biofertilization with effective strains of *Rhizobium leguminosarum* biovare phaseoli and a rhizobacterial preparate "Biofertile" accompanied or not with one type of organic fertilizers "Botanical-waste compost (Compost1) or animal – botanical-waste compost (Compost 2)" or inorganic fertilizer (N) 75% of the recommended doses *i.e.*, 60, 60, 45 kg fed^{-1} of NPK fertilizers respectively. The obtained results indicated that inorganic nitrogen fertilizer enhanced some measured plant growth parameters. $plant^{-1}$ as branch numbers, leave number, leave area, root length. Biofertilization improved nodulation and significantly increased yield compared with uninoculated control. Maximum vegetative growth was scored of snap bean plants particularly those received mixed inocula of Biofertile plus and multi-strain rizobial inocula. The interaction among inorganic fertilization or Compost II combined with mixed Biofertile and multi-srain rizobial inocula showed significantly higher values in all measured plant growth parameters as well as green pod yield and quality with improved plant foliage and pod N, P, K-contents.

Key words: Snap bean cv. Paulista, compost, strains of rhizobium, Biofertile

CONTENTS

Acknowledgement

First of all and for most , I would like to express my deepest thanks to Allah who helped and gave me time . patience and power to complete this work .

I would like to express my sincere thanks and appreciations ***Dr . Hassan Ali Hassan*** *Associate Prof. of Vegetable crops, Faculty of Agriculture Cairo University, for his effective supervision and suggesting the research problem, planning of this investigation, valuable discussion, valuable help during the field work.*

My deepest thanks and gratitude are also due to Prof. ***Dr. Mohamed Abdel-aleem Ali.*** *Prof. of Microbiology, Faculty of Agriculture , Cairo University , for continued assistance and guidance through the course of my study, kind guidance positive criticism and for their revision of the manuscript.*

My heart full thanks and gratitude to Prof. ***Dr. Samira Mahmoud El-Gizy****, Prof. Dr. Vegetable crops , Horticulture Research Institute , Agriculture Research Center, for the supervision , continuous advice and her kind help during this study and reviewing the manuscript.*

Thank are also extended to the technicians and co-workers of the Vegetable crops , Horticulture Research Institute , Agriculture Research Center, for help and support.

thanks are due to staff members of Department of Agricultural Microbiology, faculty of Agriculture, Cairo University, for kind co-operation during the course to the experiments.

INTRODUCTION

Due to its high nutritive value, snap bean (*Phaseolus vulgaris*, L) is one of the most important legume crops grown in Egypt for either local marketting or exportation. Green pods of bean are rich in proteins and contain considerable amounts of carbohydrates, vitamins and minerals. According to Egyptian Agricultureal Export Unoin reports, snap bean is the second export crop with an exported quantity of 26855 tons of green pods in 2012. The cultivated area with this crop was estimated by the Department of Agricultural Statistics, Egyptian Ministry of Agricultural and land Reclamtion in 2012 to reach 57873 feddan producing about 251279 tons of green pods with an avrange yield of 4.34 tons per feddan.

Compost and bio-fertilizers are the backbone source of plant nutrients and as potential conditioners for soil fertility building and sustainable organic farming production. Such crop production approach is globally mandated by the international trade standards in particular European countries as an aspect of environmental pollution control for diminishing health hazards associated with rigorous agrochemical appplication (Kabeel *et al*. 2006). In organic farming system, plant growth vigor is strongly associated with effective nodulation and successful symbiotic performance by the legume and its rhizobial partner. For snap bean, nodulation failure or lack of response to inoculation has been frequently reported in Egyptian soil, which raises doubts about the benefits of rhizobial inoculation. Failure of nodulation was attributed to some abiotic and biotic stresses as soil salinity Bender and Rolfe, 1985; Elsheikh and Wood, 1995; Amarger *et al*. ,1997;

Cordovilla *et al*. 1999 soil acidity Graham and Parker ,1964; Evans *et al*. ,1988 , rhizophage Piha and Munns ,1987; Priefer *et al*. 2001 , high rhizosphere temperature Nogales *et al*. 2002 and incompatibility between rhizobial strain and plant genotype Karanja and Wood , 1988, Moawad and Beck ,1991. Failure of nodulation and lack of response to inoculation might be the reason for the low rate of nitrogen fixation by snap bean compared to other plant legumes. Of the total assimilated nitrogen, the percentage of biologically fixed nitrogen by *Phaseolus vulgaris* is ranged from 40−50% compared to 75% with faba beans, 70% with peas and up to 95% with lupines (Werner, 1999). Dual rhizobial inoculation with inocula strains of diazotrophes was reported to increase nodulation by snap bean (Straub *et al*. 1997). Several Plant Growth Promoting rhizobacteria (PGPR) simulate plant growth vigor via nitrogen fixation, phosphorus solubilization, production of auxins that stimulant root growth and production of antibiotics and hydrogen cyanide (Lugtenberg and Kamilova, 2009). It is therefore crucial to examine the impact of organic fertilizer application, dual inoculation with effective rhizobial strains and/or PGPR on achieving maxima nodulation, N_2- fixation, growth and yield of snap bean grown in newely-reclaimed soil.

Therefore the present study was planned to investigate:

1. The capacity of multi-strain rhizobial inocula and /or rhizobacteria to support plant growth vigor, improve nodulation and green pod yield of snap bean.

2. The effect of the type of organic fertilizer on nodulation, growth and green pod yield of snap been plants. This might contribute to improve

bean pod production quantity and quality under Egyptian newly reclaimed soil conditions.

REVIEW OF LITERATURE

1. Plant foliage

a. Effect of organic types on plant foliage

Abdel-Mawgoud (2006) investigated the interactive effects of different irrigation levels and compost applications on growth, yield and quality of green bean crop. Vegetative growth *i. e*, plant height, number of leaves, plant fresh and dry weight responded positively to the individual effects of increasing compost application rates. Ebadah *et al*. (2006) showed that the positive control were obtained for the tested bean growth parameters owing to the organic manuring of bean plants with the diverse composted agricultural residues without significant variations. Kabeel *et al*. (2006) compared the effect of chemical fertilizers and the combinations between organic manures (compost or chicken) and bio-fertilizer (Azotobacter and Azospirillum) on snap bean growth under low tunnel conditions. Data revealed that the combination between bio fertilizer and organic manures especially chicken manure, increased plant vegetative growth, i.e., plant height, number of leaves, plant dry weight, number of branches per plant and leaf area, than chemical fertilization. Uyanöz (2007) evaluated the effect f bio-organic (farm yard manure, mycorrhiza and rhizobium) and chemical fertilizers (ammonium sulphate) in single, dual, triple and quadruple combinations on dry bean. The results showed that the highest plant height after treatment of snap bean with mycorrhiza, farm yard manure and ammonium sulfate. Otieno *et al*. (2007) investigated the response of grain legumes to rhizobial inoculation, farmyard manure and mineral fertilizer nitrogen. Manure application did not have

significant effect on nodulation in all examined legumes. Abd El-Hady (2008) showed that high level of compost application *i.e.*, 20m^3/fed was better than low level of 15 m^3/fed for vegetative growth enhancement, *i.e.*, shoot number per plant and average fresh and dry weight of green bean plants. Sulieman and Hago (2009) tested the response of common bean to phosphorus as influenced by farmyard manure. The application of phosphorus and farmyard manure increased common bean shoot and root dry matter accumulation, number of branches/ plant and plant height but the increase was not a significant. Manivannan *et al*. (2009) studied the effect of vermicompost, in comparison to inorganic fertilizers-NPKon the growth, yield and nutrient content of beans. They found that growth parameters as shoot and root length, leaf area index and number of root nodules were enhanced with 50% vermicompost supplemented with 50% NPK. Abdel-Mawgoud *et al*. (2010) studied the effect of potassium humate and compost applications on green bean plant *Phaseolus vulgaris* cv. Pulista grown under Egyptian saline soil conditions. The authors found that with low level of salinity treatments, only high rates of potassium humate or compost applications had positive significant effect on plant growth parameters. Roy *et al*. (2010) used paddy straw and *Ageratum conyzoides* residues as direct mulch, compost, and vermicompost in different plots planted with *Zea mays, Phaseolus vulgaris* and *Abelmoschus esculentus*, separately in three experimental plots. Maximum productivity of aboveground biomass of *Z. mays, P. vulgaris* and *A. esculentus* was recorded in plots amended with vermicompost and the minimum rate of biomass production was exhibited by the

control, the maximum root length was recorded with compost-treated *Phaseolus vulgaris*. Satti *et al*. (2010) evaluated some organic materials and a bio-fertilizer on pests' status and performance of snap bean under heavy clay saline soil conditions. The treatments of chicken manures + neem spray and chicken manures+ neem seed powder+ neem spray gave the highest values of root dry weight compared with the control. In Egypt Shehata and El-Helaly (2010) studied the effect of compost treatments at 4t/fed, 8 t/fed, mineral fertilizers as a control and compost at the same rates with foliar application of Humic and Amino acid on Snap bean. They reported that mineral fertilizers resulted in the highest plant growth in the second season, while no significant differences were detected among treatments in the first season. Treatment with compost at a rate of 8 + Humic acid increased the number of branches/ plant. Darwish (2011) investigated the response of snap bean to different rates of compost and time of application in comparison with two different sources of mineral fertilizer. The highest value of plant height was obtained with plants received mineral fertilizer in first season while no significant differences were detected between treatments in number of branches per plant. Singh *et al*. (2011) investigated the effects of vermicompost, NPK fertilizer and mulch on growth, nodulation and pod yield of French bean. Shoot growth traits, namely shoot length, number of primary branches, shoot fresh weight and shoot dry weight were increased by 28-63% through application of N, P_2O_5, K_2O 7.5:12.5:10 $kg \cdot ha^{-1}$ + vermicompost 3.75 $t \cdot ha^{-1}$, nodule fresh weight and nodule dry weight by 44.9 and 44.5%, respectively compared with application of 100% rate of mineral

fertilizer (N, P_2O_5, K_2O 30:50:40 kg·ha^{-1}). The effect of four different seaweed compost levels (0, 1, 2 and 3 m^3 seaweed compost/feddan) and four concentration of seaweed extract (0, 250, 500, 750 ppm) as a foliar application on vegetative growth, flowering characteristics, yield parameters and chemical composition was exmined by Abou El-Yazied *et al*. (2012). Seaweed compost application at rates of 3m^3 or 2 m^3 per feddan gave the highest value on vegetative growth. El-Tanahy *et al*. (2012) investigated the effect of Chitosan, organic (cattle manure and compost) and mineral fertilizer (NPK) on vegetative growth and productivity of cowpea plants and found that the highest values of growth parameters were obtained by using the mineral fertilizer followed significantly in decreasing order by compost then cattle manure. Mineral fertilizer had a superior effect on all measured vegetative parameters such as plant height, number, fresh , dry weights of leaves, shoots and number of leaves. These results were true in both seasons with the exception of number of leaves in second season. Abbas *et al*. (2013a) studied the effect of organic fertilizers on growth and yield of *Phaseolus vulgaris.* Application of compost mixture with maize stalk or only decomposed maize stalks increased root length and fresh weight. Arjumand banu *et. al*. (2013) found that application of NPK (100%) +FYM (5Kg /ha) or poultry manure+ 100% NPK recorded maximum number of leaves, number of branches and plant height of French bean.

Mahmoud *et al*. (2013) found that vegetative growth of pea plants i.e. number of leaves and shoots as well as fresh and dry weight of whole plant was gradually and significantly (with no significant effects